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METHOD FOR DATA MODELING WITH PER MODEL

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Abstract: In this paper the method for data modeling in particular problem area with usage of PER model is presented. In it the glossary of terms, brief description of the PER model and guide for implementation was included.
Key words: SID, eTOM, Enterprise Architecture, Data Architecture, Data Modelling

1. INTRODUCTION

The method as a rule is an algorithm or procedure for carrying out purposefully activities with particular tools. It is close to the notion of technology.

A method for data modeling with PER model is presented in this paper. The purpose of the paper is to present a methodology developed by the authors for Enterprise data modeling (Tujarov at al, 2013b) using the PER model (Tujarov at al, 2013a), which is based on the process approach and develops the ideas set out in the ER model of Chen and TM / P model code in several directions:

- Create a new classification of objects.
- Add the process as a new type of object.

It has different levels of object types, so there is no ambiguity in determining the type of relationship between objects (Milev, 2013a), (Milev and Kalchev, 2013a), (Milev, 2013b). The method includes:

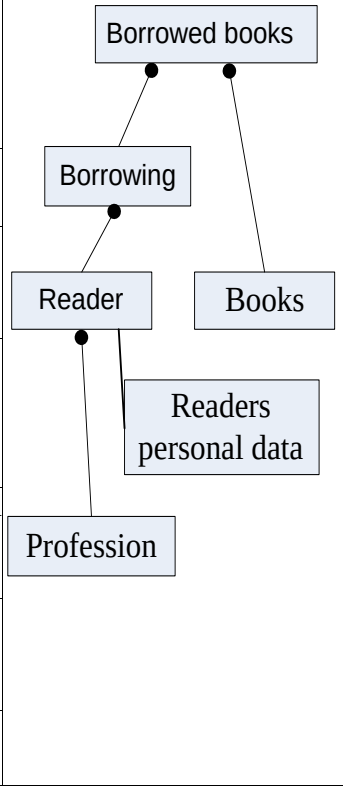
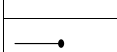
- Brief description of the PER model (view point 2).
- Glossary of terms (view point 3).
- Activities in realizing a method (view point 4).
- System information chart (view point 5).
- Recommendations about application design (view point 6).

For presenting the method, an exemplary data model in problem area ***"University"*** was used.

2. BRIEF DESCRIPTION OF THE PER MODEL

The PER model is semantic conceptual data model (Delcambre et. al.) that belongs to the class of ER models (Chen et al, 2007), (Chen). It is based on the process approach and proposes a new classification of the objects. The table bellow presents the essence of the model.

Table 1.

SYMBOL	MEANING	EXAMPLE	DESCRIPTION
AO	Associative object		Logical connection between two or more objects. Used in relations of type "many to many". Presented by expression – sale of products, students exam, borrowing of a book etc.
PO	Process object		Include data of the process, subject to modeling. Presented by a verb – sell, buy, order.
BO	Basic object		Include basic data of the objects that take part in the process – direct or indirect. Presented by a noon – clients, products, books, authors.
SO	Subordinate object		Include detailed data for the basic object. Presented by the name of the basic object and explanatory suffix – client FD, client COM, client ID.
OL	Object fixed list		Include relatively unchangeable data for an attribute of the basic object. Presented by a noon – city, profession, education, department.
	attribute		Property of the object of the real world. Every attribute has a value that identify a particular object – number, name, price, date.
	1:N 1: 1		Type relationships between objects.

3. GLOSSARY OF TERMS (Mallikaarachchi), (Repa, 2012)

Information modeling – the formation part of data modeling (Lee).

Information model – presents concepts important for business, entities and properties, independently from their practical realization (Blaise and Dudek, 2005).

PER object model – the combination of all of the objects and their relationships in particular problem area. The objects are arranged in hierarchical structure according to rules, specific for the model.

Information entity (object) – data unit with set of attributes that participate in relationships with other entities. It can be material object, activity, or concept.

Associative objects – logically links two or more type objects. It is applied in relations of type “many to many” and uses composite primary key.

Process object – includes data for the process, subject to modeling. It is presented by verb – sell, buy, order.

Basic object - Include basic data of the objects that take part in the process – direct or indirect. Presented by a noon - clients, products, books, authors.

Subordinate object - Include detailed data for the basic object. It is presented by the name of the basic object and explanatory suffix – clientFD, clientCOM, clientID.

Subsidiary objects – kind of objects which exists relatively independent in application and don’t participate in process. They might be fully independent or linked with basic objects in “many to many” type of relationships. Example: authors, student events etc.

Object fixed list - Include relatively unchangeable data for an attribute of the basic object. It is presented by a noon – city, profession, education, department etc.

Attribute – a characteristic of the object. Every attribute has a value for every object instance and which aids object identification.

Individual attribute – a properties which are specific to the object and are defined unambiguously.

List attributes – a property which can have many values and can be presented by list. Example: official position, type, color etc.

Domain – an area that includes a number of closely linked objects, values etc. (http://tuj.asenevtsi.com), (Tujarov at al., 2011).

Building blocks – described particular architectural decisions, which are typical and could be used repeatedly in different applications (Milev, 2010), (Tujarov at al., 2010).

4. ACTIVITIES IN REALIZATION OF THE METHOD

The activities in the method and sequence of their implementation are presented in seven steps, which are shown in fig. 1. They begin with the object process and depending on the functions which it implements the data model is developed, according to the specific subject area.

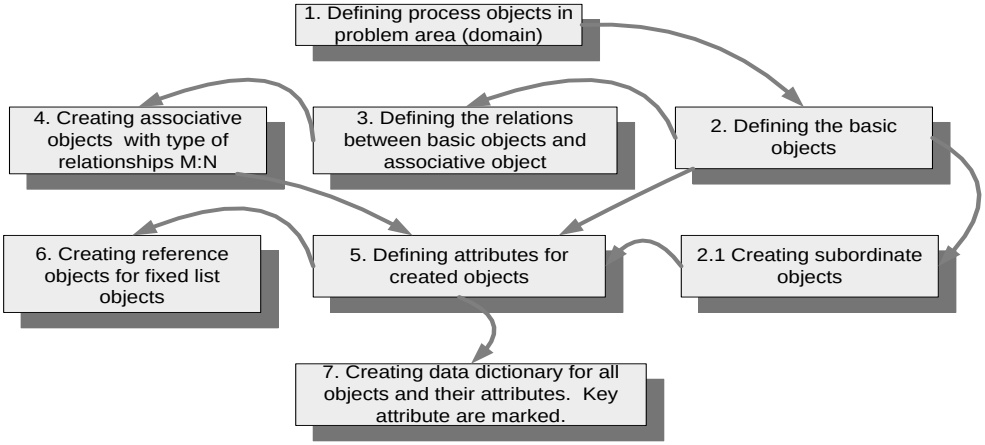


Fig.1. Activities in realization of the method.

4.1. Defining process objects in problem area

In defining of the processes eTOM model (Cisco System, 2010), (eTOM, 2003) is used, but only its structure and processes which are analogous with the process in the respective problem area.

Potentialities of the eTOM model

- Creating fundamental model of the business processes in the problem area and subsequent development of the architecture of the enterprise (http://tuj.asenevtsi.com).
- Conducting complex analysis, design and optimizing of business processes.
- Finding of a duplicate processes and their removal.
- Assessment of the cost, effectiveness and other parameters.

Advantages of implementation of the eTOM model (http://www.tmforum.org), (International Telecommunication Union, 2005)

- The universality of the model and the possibility of continuous improvement (http://tuj.asenevtsi.com).
- Integration with other methodologies such as BSC (Friedag and Schmidt, 2011), ITIL (Beims, 2012), CRM (Raab and Werner, 2010), SCM etc.
- The possibility to be used in every telecom company (or other) regardless of the scope of the problems.
- Considerable savings of recourses in developing the architecture of business processes of the company.
- Usage of good practices.

Example: In this example the process "Education", according to ETOM model, is divided into three levels. The activities in development of PER model are presented with process "Exam" as follows:

1. Defining the process (2^{nd} level of decomposition of an eTOM) – exam.
2. Defining the basic objects – lecturer, student, subjects.
3. Defining the relationships between basic objects and object process – subject, student.
4. Creating associative objects – lecture, student tested .
5 . It isn't shown.
6. Creating fixed list objects- assessment, course, type, specialty, official position

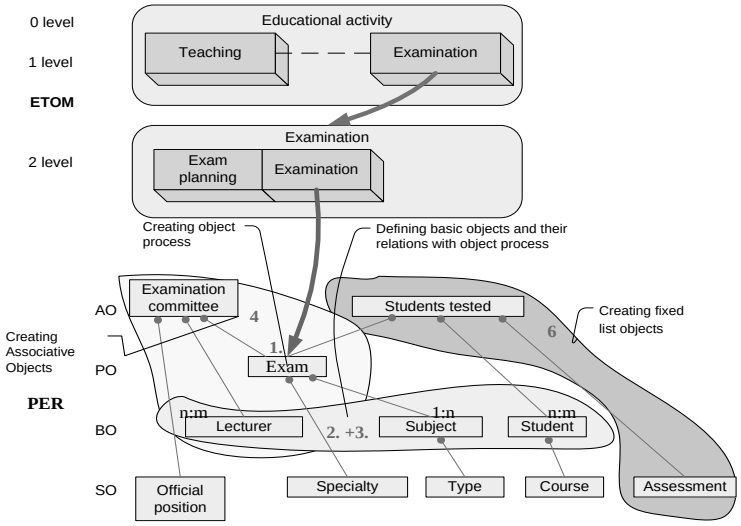


Fig.2. Education.

4.2. Defining basic objects in the process

The basic objects are a core of the data model. They are linked with process object semantically, e.g. they are entities which realized process. For defining basic objects the following question was put:

Q: Who participate in the exam?

A: The lecturers, subjects and students.

These basic objects participate in the process exam with main data only (for example students – number, name and specialty), but in the problem area with much more information (Personal student's data, communication with student, student's biography).

For gathering all of the data for basic object, the system information chart is created. The objects in the chart are divided into domains, according to nature of the information they described. Every domain is relatively enclosed, but the elements within are strongly attached.

4.3. Defining relationships between objects

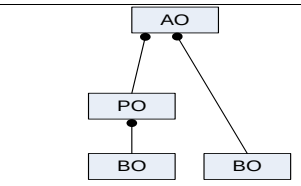
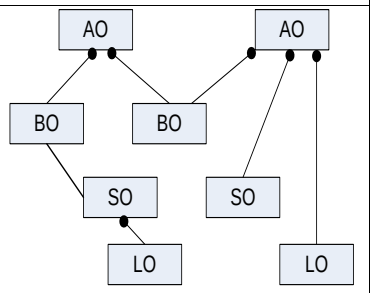
Two types of relationships are defined:

- Process – basic object. Examples: borrowing – reader.
- Basic object – subordinate or list object. Examples: book – authors; language – level of command; students – events.

The tabl.2 shows the main types of relationships between object in PER model 1 : 1, 1 : n, n : m

TABLE2.

RELATIONSHIPS BETWEEN OBJECTS	TYPE OF RELATIONSHIP	EXAMPLE DIAGRAM

process object (PO) - basic object (BO). In this case, two variations are possible.	1:n - the basic object participate in object process (with foreign key). n:m - the basic object together with process object participate into newly created associative object (AO).	
basic object (BO) – subordinate object (SO) or object list (LO). In this case, tree variations of relationships are possible.	1:1 – the subordinate object has the same key as the basic object. 1:n – the subordinate object or object list are included in the basic object (with foreign key). n:m – a new associative object (AO) is created which includes the basic and subordinate object (with foreign key).	

4.4. Creating of the associative object

Associative objects are created when they are relationship n:m between:

- A process object and a basic object. Examples: student tested (exam, student).
- A basic object and subordinate, subsidiary or object list. Examples: biography (students, event, place of event).

4.5. Defining the attributes of the created objects

The task for defining attributes of the object in the PER model is complex for semantic presentation as well as for formalization. In the tables 3 and 4 we attempt to make such description as follows.

Table 3 presents the attributes of main objects and the way they can be defined on the example of "Exam" data model (http://tuj.asenevtsi.com), (International Telecommunication Union, 2009).

Table3.

QUESTION	EXEMPLARY ATTRIBUTE
Object process - Exam	
Individual properties Who participate and how?	ID, Name, Lecturer n:m, Subject 1:n, Student n:m
When?	Date, Time.
Where?	City, Building, Lecture hall.
What kind of document?	Report, Protocol.
Other characteristics	
Associative object – students examined	
Which objects are linked?	ID Exam, ID students.
Which measure?	Assessment
How many?	A number
Basic object – lecturer, subject,student	
Individual properties	ID, name, specialty
Properties of type fixed list	Specialty, Type, Assessment

Object list – specialty, course, semester	
Individual properties	ID, Name

Table 4 presents the exemplary formalized list of attributes of a basic object "Subjects" (http://tuj.asenevtsi.com), (International Telecommunication Union, 2009).

Table4.

OBJECT NAME	SUBJECT			
Attribute name	Description	Type data	Required / Optional	Notes
ID	Identifier of the subject.		Required	
Name	Subject name.		Required	
Description	Detail description of the subject.		Required	
Operational period	Period in action.	Time	Optional	
Type	In which category belongs.		Optional	
Status	What status has?		Required	

4.6. Creating of the object lists

The list objects are created after defining the attributes of the objects. Examples: type of product; genre of a book; color of hair etc.

5. SYSTEM INFORMATION CHART (International Telecommunication Union, 2009), (Strassner at al.,2004)

The System information chart (see fig. 3) is a tool for description of the problem areas.

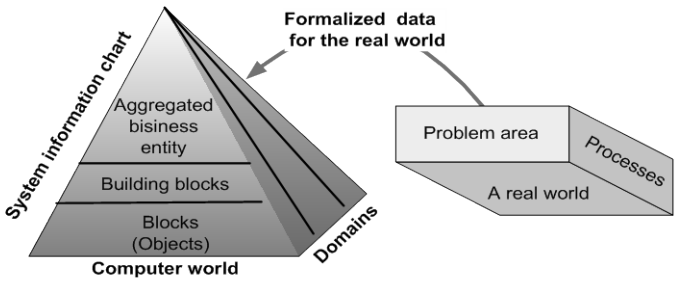


Fig.3. System information chart.

It includes domains that represented aggregated bisiness entity (ABE) (Pignatelli and Motta, 2008)(International Telecommunication Union, 2009) – closely linked different objects, united in one group. Example: lecturers, students, subjects.

Building blocks – presented particular architectural decisions that appears as typical and can be used repeatedly in different applications (http://tuj.asenevtsi.com), (Tujarov at al., 2011).

Example of building blocks: Communication with the student, Biography of the student, usage of foreign languages etc.

Blocks (called Objects) - entities located on different hierarchical level of the PER model according to their purpose (Milev, 2010), (Tujarov at al., 2010).

Example of the ABE – student

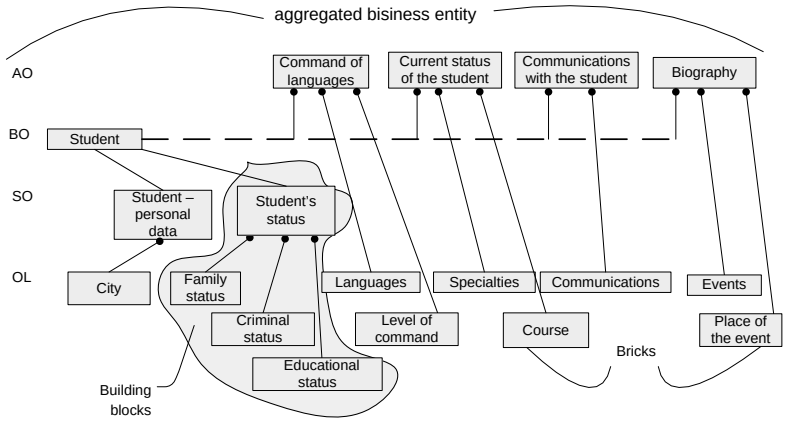


Fig.5. ABE – student

6. RECOMMENDATIONS FOR APPLICATIONS DESIGN

Important advantage of the PER model is the possibility of drowning certain rules for application design. Table 5 presents recommendation for developing the basic objects attributes in the PER model.

Table5.

OBJECT NAME	INPUT FORM	EXAMPLE
Process object	Single Form	The main form – exam with sub forms committee and students examined.
Basic object	Single Form	The main form – student with the sub forms – languages, status, communication, biography.
Associative object	Tabular form	Sub-form - knowledge of languages, ID student synchronization.
Subordinate object	Single Form or tabular form	Main form – student with sub form student's status.
Object list	Tabular form	Single form – languages, level of command.
Object list attribute – foreign key	Combo box or list box	ID of language into the form for command of languages. ID communications into the form for communications with the student.
Text attributes	Text box	Name of the student.

An example of the realization of the model in accordance of the recommendations is given in figure 6.

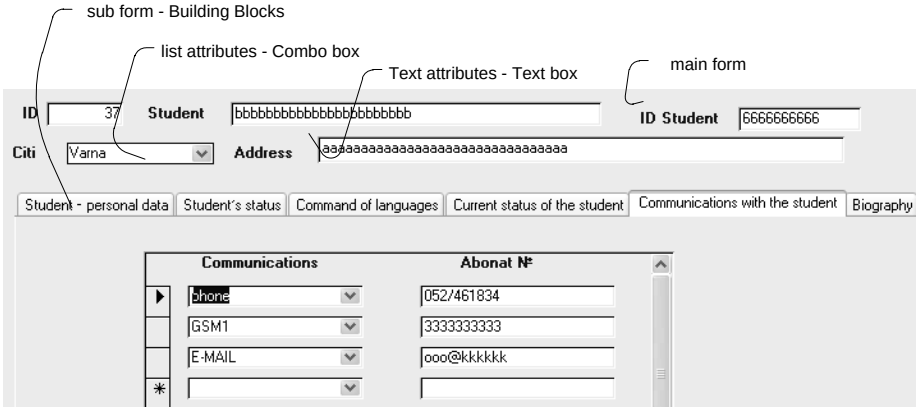


Fig.6. Realization of the PER model.

7. CONCLUSION

The method presented in this paper describes a sequence of activities for data modeling by PER model. It is concise guide, describing the sequence of activities in Enterprise data modeling by PER model (Milev and Kalchev,2013b). The method enables better realization of the possibilities of the presented model for semantic data modeling (Milev, 2013a), with ABE (Milev and Kalchev,2013d), primarily created with building blocks. The method can be used in education (presented in the paper) as well as in the development of information models in different areas.

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